BOOKS: COGNITION

Tales of a Talented Bird

Edward Kako

In June 1977, Irene Pepperberg went to a Chicago pet store, purchased an African Grey parrot, and named him Alex. She trained Alex to speak and comprehend some English, then used his linguistic capacities to explore the workings of his mind. Now, nearly 25 years later, we know that Alex can name and categorize numerous objects, judge their relative sizes, and count. He can make requests like "wanna go gym." He can refuse objects that are offered to him by saying "nuh." How these abilities were revealed—and what they might mean for our understanding of an animal mind—are the subjects of Pepperberg's stimulating new book, *The Alex Studies*.

The Alex Studies Cognitive and Communicative Abilities of Grey Parrots
by Irene Maxine Pepperberg

Harvard University Press, Cambridge, MA, 1999. 446 pp. $39.95, £24.95. ISBN 0-674-00051-X.

To teach Alex English, Pepperberg used a method built around intensive social interaction with his trainers. This method, called the model-rival technique, requires Alex to interact with a principal trainer (A) and with a second trainer (B) who acts both as the model for his behavior and as the rival for the principal trainer's attention. Trainer A asks trainer B to produce the label of an object ("pasta," for example); when B does so, A then asks Alex to do the same. Rather than getting food when he succeeds, Alex gets the object he is being asked to label. If he prefers a different object, he must first produce the label for the test item.

Pepperberg's work is admirably rigorous. Earlier work with language-trained animals was notorious for poor design and overly charitable interpretation of data (*1*, *2*). Pepperberg, by contrast, takes careful precautions against inadvertent cueing. She uses conservative estimates of chance when assessing the statistical reliability of Alex's responses, and she shows restraint when interpreting her results.

Pepperberg has organized her book in a quasi-historical fashion, framing each phase of her research in terms of the contemporary work that inspired or informed it. Each chapter is devoted to a particular capacity or competence, such as numerical cognition, categorization, or the comprehension of words. Throughout the book there is a certain amount of redundancy about experimental methods. For those who choose to read the book in its entirety, such redundancy might prove somewhat tedious. For those who wish to read selectively (or for instructors who wish to assign only one or two chapters), it should be quite welcome because each chapter can stand on its own reasonably well. Pepperberg's prose is generally clear and straightforward. The book should be accessible to a wide range of audiences, from researchers studying animal behavior to advanced undergraduates in a course that covers relevant material such as animal cognition or the capacities of language-trained animals.

Pepperberg repeatedly eschews the idea that Alex's linguistic abilities are interesting in and of themselves. Instead, she uses them as a way to assess his cognitive capacities, which are striking: He classifies objects according to color and substance; counts up to six; understands the concepts of identity and difference, absence, and relative size; and recognizes that objects continue to exist even when they are hidden. The extent to which these abilities depend on Alex's linguistic training is a question of considerable importance. It is also a question that is very difficult to answer (*3*), though Pepperberg firmly maintains that language training affects "only the *ease* with which animals can learn and be tested on certain concepts, not *whether* learning occurs" (emphasis in the original).

Color comprehension. A test for Alex.

CREDIT: WILLIAM MUÑOZ/FROM *THE ALEX STUDIES*

Pepperberg's protests notwithstanding, I must admit that as a psycholinguist, I find Alex's linguistic abilities the most fascinating of his talents. In addition to being able to label objects and their properties (color, material, and shape), Alex can combine the words in his repertoire in some limited—but still quite impressive—ways. He combines the words "want" and "wanna" with object labels to express his desires (for example, "want corn" or "want grape"). He also combines the phrase "wanna go" with labels for locations ("wanna go gym" or "wanna go chair"). Interestingly, he never combines "wanna go" with object labels nor "want" or "wanna" with location names. For Pepperberg, these combinations represent a form of "predication, which implies an extremely simple form of syntax, but a form nonetheless." These combinations are at least partially syntactic, but it is not clear that they are sufficient evidence of predication. Besides "go" and variations of "want," Alex knows only two other verbs ("come" and "tickle"), both of which are embedded in phrases that do not vary ("come here" and "you tickle me"). Given the centrality of verbs to predication in human language, the claim of predication would be more compelling if Alex combined, in an ordered fashion, more verbs with a variety of object labels (*4*). Alex's comprehension abilities are also impressive. Presented with an array of objects that vary in color, shape, and material, he can respond accurately to such questions as "What shape is the green paper?" or "What object is five-corner [pentagonal] purple?"

Why does Alex have these capacities? What are the implications of Pepperberg's work for our understanding of human language acquisition or evolution? In keeping with the rigor of her experimentation, the author resists answering such questions because there are "few ways of designing appropriately rigorous tests of any possible theory." Despite her hesitancy, Pepperberg suggests that Alex's acquisition of English as an "allospecific code" might resemble the acquisition of human language under atypical circumstances—such as in cases of language delay or of learning a second language later in life. Indeed, some of the most tantalizing results of Pepperberg's studies have to do with how dependent Alex's successes have been on the specific properties of the model-rival technique. In a highly informative series of experiments involving Alex and two juvenile birds (Kyaaro and Alo), Pepperberg showed that her parrots would learn new words only when the trainer and the subject interacted socially, when the word clearly referred to something, and when the word could be used to achieve a particular outcome. In the absence of any of these factors, the birds learned much more poorly, if at all. (Likewise, parrots kept as pets can learn to mimic what they hear, but do not understand what they are saying—hence the origin of the phrase "to parrot.") Given the importance of social interaction and enculturation for the success of the Alex studies, it is

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interesting to note that many language acquisition researchers have recently begun to emphasize the importance of these factors for children (*5*, *6*).

Of course, African Grey parrots do not ordinarily acquire referential, functional use of words, or the capacity to combine them. The human talent for language surely has something to do with our biological preparedness—a preparedness so robust that language is learned under an enormous variety of circumstances (*7*). But if biological preparedness were all, Alex should have learned nothing. A major contribution of *The Alex Studies* is to suggest that we should not underestimate the contribution of culture and social interaction to our own language development.

References

1. C. A. Ristau and D. Robbins, *Adv. Study Behavior* **12**, 141 (1982).
2. H. S. Terrace, L. A. Pettito, R. J. Sanders, T. G. Bever, *Science* **206**, 891 (1979).
3. D. Premack, *Behav. Brain Sci.* **6**, 125 (1983).
4. E. Kako, *Anim. Learn. Behav.* **27**, 1 (1999).
5. D. A. Baldwin, *Child Dev.* **62**, 875 (1991).
6. M. Tomasello, in *Beyond Names for Things: Young Children's Acquisition of Verbs*, M. Tomasello, W. E. Merriman, Eds. (L. Erlbaum, Hillsdale, NJ, 1995), pp. 115–146.
7. L. R. Gleitman and E. L. Newport, in *An Invitation to Cognitive Science, Vol. 1: Language*, L. R. Gleitman and M. Liberman, Eds. (MIT Press, Cambridge, MA, 1995), pp. 1–24.

BOOKS: BIOWEAPONS

Disdained by Generals

Raymond A. Zilinskas

Although many of the world's nations have sought to acquire biological weapons, only rarely have these weapons been used in conflict. So why do governments seek these weapons? And why do their generals chose not to deploy them? In *The Biology of Doom*, writer and former philosophy professor Ed Regis describes the biological warfare programs of the United States, the United Kingdom, Canada, and Japan. His historical study emphasizes the efforts of the United States and grapples with the question of why biological weapons have seen so little use.

As World War II began, British intelligence concluded that Germany was conducting a biowarfare program. In response, the British began to develop biological weapons at Porton Down. Soon, collaborations were set up among Canadian, British, and U.S. programs. The U.S. activities soon dwarfed those of its allies. In the post-war years, the Canadian program was discontinued and the U.K. program faded, but the U.S. effort grew to huge proportions. Using previously inaccessible information acquired through the Freedom of Information Act, Regis tells fascinating snippets of events that occurred in those days. These include the testing of biological materials over, in, and under U.S. cities; the activities of the Central Intelligence Agency to develop fanciful weapons based on microorganisms, toxins, and psychedelics; the use of Christian Scientists as human subjects in field experiments; and Chinese allegations that the U.S. employed biological weapons during the Korean conflict.

The Biology of Doom
The History of America's Secret Germ Warfare Project
by Ed Regis
Holt, New York, 1999. 267 pp. $25, C$37.50. ISBN 0-8050-5764-1.

By the time the U.S. biowarfare program was abolished by President Richard Nixon in 1969, it had deployed five so-called validated biological weapons systems. Three were based on incapacitating agents (*Brucella suis*, *Coxiella burnetii*, and Venezuelan equine encephalitis virus) and two on lethal agents (*Bacillus anthracis* and *Francisella tularensis*). In addition, several species of microorganisms that cause a variety of animal and plant diseases had been developed for weapons use, but these were not formally validated. All offensive agents were destroyed during 1969 and 1970. As far as is known, none of the products developed by the United States over the 26-year span of its bioweapons program were ever used in actual conflicts.

If the book's strength lies in its accurate accounting of the history of the U.S. biowarfare program, its main weakness resides in Regis's narrow focus. He declines to explore the international political environment in which this program operated. From reading *The Biology of Doom*, one would never know that a Cold War raged after World War II nor that Warsaw Pact forces with nuclear, chemical, and biological capabilities faced NATO across Europe. Was the U.S. bioweapons program designed to counter a like threat posed by the Soviet Union? Or was it a juggernaut that took on a life of its own without the benefit of outside stimuli? The author does not tell us.

The book has a rather odd format; in some ways it resembles a novel. There is no introduction or table of contents, the chapters are untitled, and no citations or references are provided in the text. Furthermore, Regis uses certain techniques common to fiction, such as ascribing imaginary feelings to historic persona (General Shiro Ishii "had a whale of a time"), creating specious similes ("microorganisms multiply like rabbits"), and writing with a mocking or ironic tone. Perhaps this is done to attract readers from the general public. If so, I do not think it will succeed. Although the subject of biowarfare is fascinating, its treatment here does not rise to the level of drama. This shortcoming is partly due to the lack of victims; in the history of biological warfare, accidents account for only a few injuries and even fewer deaths. It is also partly due to the subject matter; after all, such arcane topics as the propagation of *Bacillus anthracis* in culture and production of botulinum toxin offer little excitement to anyone but microbiologists. In addition, Regis's depictions of scientists who conducted secret research are insipid.

Academics are likely to appreciate the book's sources of information and fine index. Regis's account, however, does not rise to the level of a stylish, elegantly written study. In particular, scholars will be irritated by the lack of explanations of the book's organization and its author's intent, the haphazardness with which topics are introduced and addressed, the stylistic idiosyncrasies noted above, and the absence of citations through which facts might be checked.

In the end, Regis argues that biological weapons have not been used because they are "silent, secret, invisible, and slow." They therefore lack the "single most important ingredient of any effective weapon, an immediate visual display of overwhelming power and brute strength." I disagree with this reasoning. Chemical weapons, which also are silent, secret, and invisible, certainly have been used in recent and past wars. Why use chemical but not biological weapons? The answer, I believe, lies primarily with logistics; it is exceedingly difficult to deploy and use biological weapons in the field in such a way that they are militarily advantageous. Only a few nations—including Japan, the United States, the Soviet Union, and Iraq—have had that ability in the past. Japan used bioweapons against China, but to little, if any, military effect. The United States and the Soviet Union seem not to have needed such weapons in the conflicts in which they became involved, although the Soviet Union probably would have used its biological weapons had war broken out between NATO and the Warsaw Pact. Iraq did not use its bioweapons, probably because they were unproven, their use would have invited powerful retribution, and the opposing forces were well protected. There does not appear to be a universal explanation why biological weapons have not been used; instead, each case is unique. Those qualities that Regis believes have so far prevented the use of bioweapons by military forces might be exactly the qualities that terrorists would find attractive for future operations.

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